Appendix B: Specifications

The HFS 9000 family of high-speed logic signal source instruments have a modular architecture with factory-configurable cards. The channels are digitally synthesized from a common clock resulting in highly accurate independent placement of rising and falling edges. The instruments are optimized for digital device characterization with unique triggering capabilities and a variety of pulse outputs. The product family also features low RMS jitter, the ability to compensate for external cable skews, and an easy-to-use graphical human interface.

This section contains the complete specifications for the HFS 9000 Stimulus System and Modules. These specifications are classified as either nominal traits, warranted characteristics, or typical characteristics.

Nominal Traits

Nominal traits are described using simple statements of fact such as "+2.6 V" for the trait "Maximum high level," rather than in terms of limits that are performance requirements.

Table B–1: Nominal Traits — HFS 9PG1 Output Performance

Each channel and complement driving a 50 Ω load to ground, except as noted.

Name	Description
Maximum high level	+2.6 V
Minimum low level	–2.00 V
Maximum amplitude	3.00 V
Minimum amplitude	0.50 V
Level resolution	0.01 V
Operation when terminated through 50 Ω to –2 V	Output levels will be approximately 1 V more negative than the values programmed, specified, and displayed. Actual output levels more negative than –2 V may cause malfunction. Level accuracy specifications do not apply when terminating to –2 V. Both true and complement outputs must be terminated to the same voltage.

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Table B–1: Nominal Traits — HFS 9PG1 Output Performance (Cont.)

Each channel and complement driving a 50 Ω load to ground, except as noted.

Name	Description
Operation when terminated to high impedance loads	Output level range will double until certain internal limits are achieved. Since the programmed, specified, and displayed output levels do not match the actual output levels, level accuracy specifications do not apply when terminating to a high impedance load. Because of the larger voltage swings associated with doubled level range, output transition time specifications do not apply when driving a high impedance load.
Output limits	One high limit and one low limit may be enabled or disabled together.

Table B–2: Nominal Traits — HFS 9PG2 Output Performance

Each channel and complement driving a 50 Ω load to ground, except as noted.

Name	Description
Maximum high level	+5.50 V
Minimum low level	–2.00 V
Maximum amplitude	5.50 V
Minimum amplitude	0.50 V
Level resolution	0.01 V
Operation when terminated through 50 Ω to –2 V	Output levels will be approximately 1 V more negative than the values programmed, specified, and displayed. Actual output levels more negative than –2 V may cause malfunction. Level accuracy specifications do not apply when terminating to –2 V. Both true and complement outputs must be terminated to the same voltage.
Transition time 20% to 80%	Variable from 800 ps to 5 ns
Transition time resolution	10 ps
Output limits	One high limit and one low limit may be enabled or disabled together.

Table B–3: Nominal Traits — HFS 9DG1 Output Performance

Each channel and complement driving a 50 Ω load to ground, except as noted.

Name	Description
Maximum high level	+5.0 V
Minimum low level	–2.5 V
Maximum amplitude	3.00 V
Minimum amplitude	0.01 V
Level resolution	0.01 V
Operation when terminated through 50 Ω to –2 V	Output levels will be approximately 1 V more negative than the values programmed, specified, and displayed. Actual output levels more negative than –2 V may cause malfunction. Level accuracy specifications do not apply when terminating to –2 V. Both true and complement outputs must be terminated to the same voltage.
Operation when terminated to high impedance loads	Output level range will double until certain internal limits are achieved. Since the programmed, specified, and displayed output levels do not match the actual output levels, level accuracy specifications do not apply when terminating to a high impedance load. Because of the larger voltage swings associated with doubled level range, output transition time specifications do not apply when driving a high impedance load.
Output limits	One high limit and one low limit may be enabled or disabled together.

Table B–4: Nominal Traits — HFS 9DG2 Output Performance

Each channel and complement driving a 50 Ω load to ground, except as noted.

Name	Description
Maximum high level	+5.50 V
Minimum low level	–2.00 V
Maximum amplitude	5.50 V
Minimum amplitude	0.01 V
Level resolution	0.01 V
Operation when terminated through 50 Ω to –2 V	Output levels will be approximately 1 V more negative than the values programmed, specified, and displayed. Actual output levels more negative than –2 V may cause malfunction. Level accuracy specifications do not apply when terminating to –2 V. Both true and complement outputs must be terminated to the same voltage.
Transition time 20% to 80%	Variable from 800 ps to 6 ns

Table B–4: Nominal Traits — HFS 9DG2 Output Performance (Cont.)

Each channel and complement driving a 50 Ω load to ground, except as noted.

Name	Description
Transition time resolution	10 ps
Output limits	One high limit and one low limit may be enabled or disabled together.

Table B–5: Nominal Traits — Time Base

Name	Description
Frequency range	HFS 9PG1, HFS 9DG1: 50 kHz to 630 MHz HFS 9PG2, HFS 9DG2: 50 kHz to 300 MHz[1]
Frequency resolution	≤ 0.1% of frequency setting
Minimum frequency setting when using half, quarter, or eighth pulse rate modes[2]	half pulse rate: 100 kHz quarter pulse rate: 200 kHz eighth pulse rate: 400 kHz
Number of pulse periods in burst or auto-burst modes	User selectable from 1 to 65,536

1 **If the HFS 9PG2 or HFS 9DG2 is operated in half pulse rate mode, frequency can be extended to 600 MHz for the HFS 9PG2 and 630 MHz for the HFS 9DG2.**

2 **All pulse rate modes result in 50 kHz output frequency.**

Table B–6: Nominal Traits — Performance to External Frequency Reference

Name	Description
PHASE LOCK IN input characteristic	0.1 µF DC blocking capacitor followed by 50 Ω termination to ground
Phase lock output frequency range	Any 2^n multiple or sub-multiple of the phase lock frequency that is within the allowed frequency range for the card being used
FRAME SYNC IN	Initiates a burst when using phase lock mode
FRAME SYNC IN input characteristic	50 Ω terminated to –2 V

Table B–7: Nominal Traits — Output Edge Placement Performance[1]

Name	Description
Channel deskew (**Chan Delay**) range, channels relative to time zero reference	–60 ns to 2.0 µs
Channel deskew (**Chan Delay**) resolution	HFS 9PG1, HFS 9PG2: 5 ps HFS 9DG1, HFS 9DG2: 1 ps
Delay (**Lead Delay**) adjustment range	Zero to 20 µs
Delay (**Lead Delay**, **Trail Delay**) adjustment resolution	HFS 9PG1, HFS 9PG2: 5 ps HFS 9DG1, HFS 9DG2: 1 ps
Pulse width adjustment range	HFS 9PG1, HFS 9PG2: Zero to (one period – 790 ps) inclusive HFS 9DG1, HFS 9DG2: Zero to (one period × 65,536) inclusive
Pulse width adjustment resolution	HFS 9PG1, HFS 9PG2: 5 ps HFS 9DG1, HFS 9DG2: 1 ps
Fine knob resolution of timing	5 ps

1 **Measured at 50% levels, each channel independent.**

Table B–8: Nominal Traits — Transducer In Performance

Name	Description
TRANSDUCER IN input characteristic	HFS 9PG1: 1000 pF DC blocking capacitor followed by 50 Ω termination to ground HFS 9PG2: 100 pF DC blocking capacitor followed by 50 Ω termination to ground

Table B–9: Nominal Traits — Skew Cal In Performance

Name	Description
SKEW CAL IN usage	Calibration use only. No signal, except from a channel **OUTPUT** connector during the calibration process, should ever be applied to this input.

Table B–10: Nominal Traits — Trigger In Performance

Name	Description
Input Voltage range	±5 V maximum
Trigger level range	±4.70 V
Trigger level resolution	100 mV

Table B–11: Nominal Traits — Trigger Out Performance

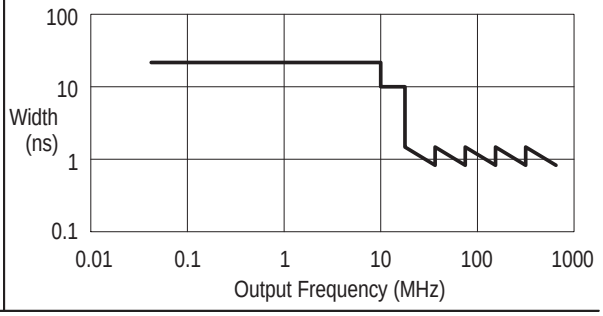
Name	Description
Pretrigger range, **TRIGGER OUT** before time zero reference	Zero to 70 ns
TRIGGER OUT pulse width in auto mode	

Table B–12: Nominal Traits — Power Requirements

Name	HFS 9003 Description	HFS 9009 Description
Fuse ratings	5 A, 250 V, type 3AG, (Tektronix part 159-0014-00), and 4 A, 250 V, type 3AG, fast blow, (Tektronix part 159-0017-00)	15 A, 250 V, type 3AG, fast blow, (Tektronix part 159-0256-00)

Table B–13: Nominal Traits — System Memory Performance

Name	Description
Non-volatile memory retention time	Instrument settings and calibration constants are retained in non-volatile memory for 5 years or more. Card identification is retained for 10 years. Extended storage above 50° C may degrade the life of all non-volatile memory.

Table B–14: Nominal Traits — HFS 9003 Mechanical

Name	Description		
Weight, in 12-channel configuration. (Shipping weight includes all standard accessories.)		Cabinet	Rackmount
	Net weight:	45 lbs. (20.5 kg)	51 lbs. (23.2 kg)
	Shipping weight:	60 lbs. (27.3 kg)	66 lbs. (30.0 kg)
Overall Dimensions		Cabinet	Rackmount
	Width:	16.3 in. (414 mm)	19.0 in (483 mm)
	Height:	7.0 in. (178 mm)	7.0 in. (178 mm)
	Depth:	24.75 in. (629 mm)	24.75 in. (629 mm)
	Depth behind rack flange:	—	22.0 in. (559 mm)
Cooling Method	Forced-air circulation with no air filter, maximum 318 cfm		
Construction Material	Chassis parts are constructed of aluminum alloy; bezel is glass-filled polycarbonate with Lexan plastic inserts; cabinet is aluminum with textured epoxy paint.		

Table B–15: Nominal Traits — HFS 9009 Mechanical

Name	Description	
Weight, in 36-channel configuration. (Shipping weight includes all standard accessories.)		Rackmount
	Net weight:	81 lbs. (33.7 kg)
	Shipping weight:	100 lbs. (45.3 kg)
Overall Dimensions		Rackmount
	Width:	16.75 in (425.79 mm)
	Height:	14.00 in. (355.89 mm)
	Depth:	24.00 in. (610.11 mm)
Cooling Method, mainframe	Forced-air circulation with air filter, maximum 318 cfm	
Cooling Method, power supply	Forced-air circulation, maximum 106 cfm	
Construction Material	Chassis parts are constructed of aluminum alloy with Lexan plastic inserts; cabinet is aluminum with textured epoxy paint.	

Warranted Characteristics

Warranted characteristics are described in terms of quantifiable performance limits which are warranted. Names of characteristics that appear in boldface type have checks for verifying the specifications in the *Check Procedures* section.

Table B–16: Warranted Characteristics — HFS 9PG1 Output Performance

Name	Description
High level accuracy (amplitude ≥ 1 V or high level ≥ 0 V)[1]	±2% of level, ±50 mV
Low level accuracy (amplitude ≥ 1 V or high level ≥ 0 V)[1]	±2% of high level, ±2% of amplitude, ±50 mV
Transition time 20% to 80% (amplitude ≤ 1 V)	≤ 200 ps

1 **If amplitude < 1 V and high level < 0 V, accuracy typically meets the specification but is not guaranteed**

Table B–17: Warranted Characteristics — HFS 9PG2 Output Performance

Name	Description
High level accuracy	±2% of level, ±50 mV
Low level accuracy	±2% of high level, ±2% of amplitude, ±50 mV
Transition time accuracy 20% to 80% (amplitude ≤ 1 V)	±10% of setting, ±300 ps

Table B–18: Warranted Characteristics — HFS 9DG1 Output Performance

Name	Description
High level accuracy (amplitude ≥ 0.5 V)[1]	±2% of level, ±50 mV
Low level accuracy (amplitude ≥ 0.5 V)[1]	±2% of high level, ±2% of amplitude, ±50 mV
Transition time 20% to 80% (amplitude ≤ 1 V)	≤ 250 ps

1 **If amplitude < 0.5 V, accuracy typically meets the specification but is not guaranteed**

Table B–19: Warranted Characteristics — HFS 9DG2 Output Performance

Name	Description
High level accuracy (amplitude ≥ 0.5 V)[1]	±2% of level, ±50 mV
Low level accuracy (amplitude ≥ 0.5 V)[1]	±2% of high level, ±2% of amplitude, ±50 mV
Transition time accuracy 20% to 80% (amplitude ≤ 1 V)	±10% of setting, ±300 ps

1 **If amplitude < 0.5 V, accuracy typically meets the specification but is not guaranteed.**

Table B–20: Warranted Characteristics — Time Base

Name	Description
Frequency accuracy	±1%

Table B–21: Warranted Characteristic — Performance to External Frequency Reference

Name	Description
PHASE LOCK IN frequency range	6 MHz to 630 MHz

Table B–22: Warranted Characteristics — Output Edge Placement Performance[1]

Name	Description
Delay of pulses relative to time zero reference (Lead Delay) accuracy	HFS 9PG1, HFS 9PG2: 1% of (**Lead Delay** + **Chan Delay**) ±300 ps HFS 9DG1, HFS 9DG2: 1% of (**Lead Delay** + **Chan Delay**) ±50 ps
Pulse width accuracy	HFS 9PG1: 1% of width ±300 ps HFS 9PG2: 1% of width ±300 ps [for widths ≥ 20 ns]; 1% of width + 300 ps, –500 ps [for widths < 20 ns] HFS 9DG1: 1% of width + 50 –75 ps HFS 9DG2: 1% of width + 50 ps, –250 ps [for widths ≥ 20 ns]; 1% of width + 50 ps, –450 ps [for widths < 20 ns]

1 **Measured at 50% levels, each channel independent.**

Table B–23: Warranted Characteristics — Trigger Out Performance

Name	Description
TRIGGER OUT signal levels	Amplitude ≥ 300 mV (–0.5 V ≥ offset ≥ –1.5 V, driving 50 Ω to ground)

Table B–24: Warranted Characteristics — Power Requirements

Name	Description
Primary circuit dielectric breakdown voltage	1500 VAC_{RMS}, 60 Hz for 10 seconds without breakdown
Primary Grounding	0.1 Ω maximum from chassis ground and protective earth ground

Table B–25: Warranted Characteristics — Environmental and Safety

Name	HFS 9003 Description	HFS 9009 Description
Temperature	Operating: 0° C to +50° C (32° F to 122° F) Non-operating (storage): –40° C to +75° C (–40° F to 167° F)	Operating: 0° C to +40° C (32° F to 104° F) Non-operating (storage): –40° C to +75° C (–40° F to 167° F)
Altitude	Operating: 4 hours at 3,048 m (10,000 feet). Derate maximum operating temperature by –1° C (–1.8° F) for each 304.8 m (1,000 feet) above 1,524 m (5,000 feet) Non-operating: 2 hours at 12,192 m (40,000 feet)	
Humidity	Operating: < 95% RH, non-condensing, from 0° C to 30° C (32° F to 86° F) < 75% RH, non-condensing, from 31° C to 40° C (88° F to 104° F) (MIL-T-28800E, para 4.5.5.1.2.2, Type III, Class 5)	
Shock (non-operating)	MIL-T-28800E, para 4.5.5.4.1, Type III, Class 5	
Resistance to mishandling during bench use (operating)	MIL-T-28800E, para 4.5.5.4.3, Type III, Class 5	
Resistance to packaged transportation vibration, sinusoidal, in shipping package	Drops of 36 inches on all edges, faces, and corners National Safe Transit Association, test procedure 1A-B-2	
Resistance to packaged transportation vibration, sinusoidal, in shipping package	Packaged sinusoidal vibration National Safe Transit Association, test procedure 1A-B-1	
Resistance to packaged transportation random vibration	MIL-STD-810D, method 514.3, category I, Figure 514.3-1	

Table B–25: Warranted Characteristics — Environmental and Safety (Cont.)

Name	HFS 9003 Description	HFS 9009 Description
Safety	Listed to UL1244 Certified to CAN/CSA-C22.2 No. 231–M89	
IEC Specifications	Installation Category II Pollution Degree 2 Safety Class I	

Typical Characteristics

Typical characteristics are described in terms of typical or average performance. Typical characteristics are not warranted.

Table B–26: Typical Characteristics — Time Base

Name	Description
RMS jitter	15 ps, ±0.05% of interval
Recovery time between bursts or auto-bursts	15 µs

Table B–27: Typical Characteristics — HFS 9PG1 Output Performance

Name	Description
Transition time 20% to 80%	Amplitude ≤ 1 V: 150 ps 1 V < Amplitude ≤ 2 V: 190 ps 2 V < Amplitude ≤ 3 V: 225 ps
Output aberrations (beginning 200 ps after 50% point of transition)	Overshoot: +15%, +20 mV Undershoot: –10%, –20 mV

Table B–28: Typical Characteristics — HFS 9PG2 Output Performance

Name	Description
Operation when terminated to high impedance loads	Output level range will double until certain internal limits are achieved. Since the programmed, specified, and displayed output levels do not match the actual output levels, level accuracy specifications do not apply when terminating to a high impedance load. Because of the larger voltage swings associated with doubled level range, output transition time specifications do not apply when driving a high impedance load.
Transition time accuracy 20% to 80%	±10% of setting, ±300 ps
Output aberrations	Overshoot: +15%, +20 mV Undershoot: –10%, –20 mV

Table B–29: Typical Characteristics — HFS 9DG1 Output Performance

Name	Description
Transition time 20% to 80%	Amplitude ≤ 1 V: ≤ 250 ps, 250 ps 1 V < Amplitude < 2 V: 250 ps 2 V ≤ Amplitude ≤ 3 V: 260 ps
Output aberrations	Overshoot: +15%, +20 mV Undershoot: –10%, –20 mV

Table B–30: Typical Characteristics — HFS 9DG2 Output Performance

Name	Description
Operation when terminated to high impedance loads	Output level range will double until certain internal limits are achieved. Since the programmed, specified, and displayed output levels do not match the actual output levels, level accuracy specifications do not apply when terminating to a high impedance load. Because of the larger voltage swings associated with doubled level range, output transition time specifications do not apply when driving a high impedance load.
Transition time accuracy 20% to 80%	±10% of setting, ±300 ps
Output aberrations	Overshoot: +15%, +20 mV Undershoot: –10%, –20 mV

Table B–31: Typical Characteristics — Performance to External Frequency Reference

Name	Description
PHASE LOCK IN amplitude range	0.8 V to 1.0 V peak-to-peak
PHASE LOCK IN transition time requirement	20% to 80% in ≤ 10 ns
FRAME SYNC IN signal level	$-1.810\ V \le V_{low} \le -1.475\ V$ $-1.165\ V \le V_{high} \le -0.810\ V$ (standard 100 K ECL levels)
Setup time, rising edge of **FRAME SYNC IN** signal to rising edge of **PHASE LOCK IN**	650 ps minimum
Hold time, high level of **FRAME SYNC IN** after rising edge of **PHASE LOCK IN**	650 ps minimum
Time from frame sync qualified phase lock clock cycle to time-zero reference	70 ns minimum, 130 ns

Table B–32: Typical Characteristics — Transducer In Performance

Name	Description
TRANSDUCER IN useful frequency range	HFS 9PG1: 25 MHz to > 1 GHz HFS 9PG2: 5 MHz to 300 MHz
TRANSDUCER IN amplitude requirement	1.0 V to 1.5 V peak-to-peak

Table B–33: Typical Characteristics — Trigger In Performance

Name	Description
Input resistance	50 Ω
Trigger level accuracy	±100 mV ±5% of trigger level
Trigger input rise/fall time requirement	≤ 10 ns
Minimum trigger input pulse width	1 ns
Trigger sensitivity	≤ 500 mV
Time from trigger in to time-zero reference	70 ns minimum, 130 ns typical

Table B–34: Typical Characteristics — Trigger Out Performance

Name	Description
Pretrigger resolution	250 ps

Table B–35: Typical Characteristics — Power Requirements

Name	HFS 9003 Description	HFS 9009 Description
Line Voltage	90 VAC_{RMS} to 130 VAC_{RMS} or 180 VAC_{RMS} to 250 VAC_{RMS}, range switched automatically	90 VAC_{RMS} to 104 VAC_{RMS} with maximum 7 cards installed, 104 VAC_{RMS} to 132 VAC_{RMS} with maximum 9 cards installed, or 180 VAC_{RMS} to 250 VAC_{RMS}, range switched automatically
Line frequency	48 Hz to 63 Hz	
Power consumption	540 W maximum	1190 W with maximum of 9 cards installed
Inrush surge current	50 A maximum up to 40 ms at 110 VAC 100 A maximum up to 40 ms at 220 VAC	

Appendix C: Interface Specifications

This appendix describes details of the remote interfaces of the Stimulus System, both the serial port (RS-232-C) and GPIB. Normally, you will not need this information to use the HFS 9000, but the information is useful when connecting to controllers of unusual configuration.

This appendix also contains general information that pertains to programming with both interfaces including a chart of the ASCII character set and a list of reserved words.

Interface Messages

Table C–1 shows the standard interface messages that are supported by the HFS 9000.

Table C–1: HFS 9000 Standard Interface Messages

Message	GPIB	RS-232-C
DCL	Yes	Yes (provided by Break)
GET	Yes	Yes (provided by *TRG)
GTL	Yes	No
LLO	Yes	No
PPC	No	No
PPD	No	No
PPE	No	No
PPU	No	No
SDC	Yes	No
SPD	Yes	No
SPE	Yes	No
UNL	Yes	No
UNT	Yes	No
Listen Addresses	Yes	No
Talk Addresses	Yes	No

Character Set (ASCII Chart)

Table C–2 shows the character set used for all messages to and from the HFS 9000. This is identical to standard ASCII.

Table C–2: The ASCII Character Set

	0	1	2	3	4	5	6	7
0	NUL 0	DLE 16	space 32	0 48	@ 64	P 80	‘ 96	p 112
1	SOH 1	DC1 17	! 33	1 49	A 65	Q 81	a 97	q 113
2	STX 2	DC2 18	” 34	2 50	B 66	R 82	b 98	r 114
3	ETX 3	DC3 19	# 35	3 51	C 67	S 83	c 99	s 115
4	EOT 4	DC4 20	$ 36	4 52	D 68	T 84	d 100	t 116
5	ENQ 5	NAK 21	% 37	5 53	E 69	U 85	e 101	u 117
6	ACK 6	SYN 22	& 38	6 54	F 70	V 86	f 102	v 118
7	BEL 7	ETB 23	’ 39	7 55	G 71	W 87	g 103	w 119
8	BS 8	CAN 24	(40	8 56	H 72	X 88	h 104	x 120
9	HT 9	EM 25	) 41	9 57	I 73	Y 89	i 105	y 121
A	LF 10	SUB 26	* 42	: 58	J 74	Z 90	j 106	z 122
B	VT 11	ESC 27	+ 43	; 59	K 75	[91	k 107	{ 123
C	FF 12	FS 28	, 44	< 60	L 76	\ 92	l 108	| 124
D	CR 13	GS 29	– 45	= 61	M 77	] 93	m 109	} 125
E	SO 14	RS 30	. 46	> 62	N 78	^ 94	n 110	~ 126
F	SI 15	US 31	/ 47	? 63	O 79	_ 95	o 111	rubout 127

Reserved Words

The following is a list of the reserved words of the HFS 9000. You cannot use these words as names of aliases.

ABUR
ABURS
ABURST
ALI
ALIA
ALIAS
ALL
AMPL
AMPLI
AMPLIT
AMPLITU
AMPLITUD
AMPLITUDE
AUTO
BAUD
BURS
BURST
CAL
CAT
CATA
CATAL
CATALO
CATALOG
CDEL
CDELA
CDELAY
CH1
CH2
CH3
CH4
CID
COAR
COARS
COARSE
COMP
COMPL
COMPLE
COMPLEM
COMPLEME
COMPLEMEN
COMPLEMENT
CONS
CONST
CONSTA
CONSTAN
CONSTANT
COUN
COUNT
COUT
COUTP
COUTPU
COUTPUT
CR
CRLF
DCH
DCHA
DCHAN
DCHANN
DCHANNE
DCHANNEL
DCYC
DCYCL
DCYCLE
DEF
DEFI
DEFIN
DEFINE
DEL
DELA
DELAY
DELE
DELET
DELETE
DESE
DISP
DISPL
DISPLA
DISPLAY
DIT
DITE
DITEM
DMEN
DMENU
DSET
DSETT
DSETTI
DSETTIN
DSETTING
ECHO
EOL
EVEN
EVENT
EVMSG
FACTORY
FINE
FLAG
FLAGG
FLAGGI
FLAGGIN
FLAGGING
FPAN
FREQ
FREQU
FREQUE
FREQUEN
FREQUENC
FREQUENCY
HALF
HARD
HEADER
HIGH
HLIM
HLIMI
HLIMIT
INP
INPU
INPUT
KEY
KRES
KRESO
KRESOL
KRESOLU
KRESOLUT
KRESOLUTI
KRESOLUTIO
KRESOLUTION
LDEL
LDELA
LDELAY
LEV
LEVE
LEVEL
LF
LFCR
LHOL
LHOLD
LIM
LIMI
LIMIT
LLIM
LLIMI
LLIMIT
LOW
LVI
LVIE
LVIEW
MAX
MESS
MESSA
MESSAG
MESSAGE
MIN
MODE
NAME
NEG
NEGA
NEGAT
NEGATI
NEGATIV
NEGATIVE
NONE
NORM
NORMA
NORMAL
ODD
OFF
OFFS
OFFSE
OFFSET
ON
ONE
OUTP
OUTPU
OUTPUT
PAR
PARI
PARIT
PARITY
PER
PERI
PERIO
PERIOD
PGENA
PGENB
PGENC
PGEND
PGENE
PGENF
PGENG
PGENH
PGENI
PGENJ
PGENK
PHAS
PHASE
PLIN
POL
POLA
POLAR
POLARI
POLARIT
POLARITY
POS
POSI
POSIT
POSITI
POSITIV
POSITIVE
PRAT
PRATE
PRET
PRETR
PRETRI
PRETRIG
PRETRIGG
PRETRIGGE
PRETRIGGER
PURGE
PVI
PVIE
PVIEW
RS232
SBIT
SBITS
SLOP
SLOPE
SOFT
TBAS
TDEL
TDELA
TDELAY
THOL
THOLD
TIN
TINP
TINPU
TINPUT
TOUT
TRAN
TRANS
TRANSI
TRANSIT
TRANSITI
TRANSITIO
TRANSITION
TRIG
TRIGG
TRIGGE
TRIGGER
VERBOSE
WIDT
WIDTH
ZERO

Using Debug Mode

You can turn on **Debug** from either the GPIB or RS-232 menu. The purpose of debug mode is to let you observe command operation as commands are sent to the HFS 9000. Debug is especially useful when you are trying to debug a program and you have the controller set to single-step through the commands.

When debug mode is on, the debug window (see Figure C-1) is displayed above the menu. This window is present regardless of which menu is displayed.

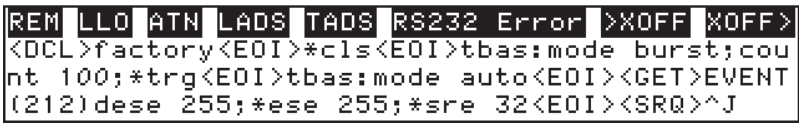


Figure C-1: The Debug Window

The bottom three rows of the debug window show the most recent commands received by the HFS 9000, regardless of which interface received them (GPIB or RS-232). The row of the debug window shows several indicators which appear only when appropriate. The indicators and their meanings are:

- REM. The HFS 9000 is in the remote state. Generally, remote means that the HFS 9000 expects to receive commands through the GPIB. If local lockout is enabled with remote, the front panel is rendered inactive (except for the **SRQ** button and the pulse generator channel buttons), and the **REMOTE** light on the front panel is lit. If local lockout has not been enabled, then front-panel commands will be entered and executed regardless of the remote or local state. When you de-assert the remote enable line, local lockout is reset automatically. Refer to the documentation on your controller to determine how you control the remote enable line.
- LLO. The HFS 9000 is in local lockout mode. The front panel is inactive when both the LLO command is received and REM (remote enable) is asserted. Use the LLO command to assert local lockout mode. Once local lockout mode is asserted, you can reset it by de-asserting remote enable.
- ATN. The attention line is asserted (low) on the GPIB. This means that the controller is sending an interface command on the bus. When not asserted, the data I/O lines are carrying data.
- LADS. The HFS 9000 is addressed on the GPIB to listen.
- TADS. The HFS 9000 is addressed on the GPIB to talk.
- RS232 Error. An error has occurred during I/O on the RS-232-C interface. Check the RS-232-C settings, especially **Baud Rate**, **Parity**, and **Stop Bits**. This error flag can also occur when the input buffer has overflowed, which

may indicate the controller failing to acknowledge that the HFS 9000 has flagged busy by sending an XOff character. See XOff> below.

You can clear the RS232 Error flag by turning Debug off and then on.

- >XOff. An XOff character has been received by the HFS 9000 on the RS-232-C controller. The HFS 9000 has responded by suspending output. When the HFS 9000 receives an XOn character, output will resume.
- XOff>. The HFS 9000 has sent an XOff character to the RS-232-C controller because the HFS 9000 input buffer is nearly full. The controller should acknowledge the XOff character by not sending any more characters until the HFS 9000 sends an XOn character. If the controller fails to respond to the HFS 9000 XOff request within three characters, the RS232 Error flag may turn on to indicate possible loss of data.

GPIB Function Subsets

The HFS 9000 supports many GPIB function subsets, as listed below. Some of the listings describe subsets that the HFS 9000 does not support.

- SH1 (Source Handshake). The HFS 9000 can transmit multi-line messages across the GPIB.
- AH1 (Acceptor Handshake). The HFS 9000 can receive multi-line messages across the GPIB.
- T6 (Talker). The HFS 9000 becomes a talker when its talk address is sent with the ATN (Attention) line asserted. It ceases to be a talker when another device's talk address is sent with ATN asserted. The HFS 9000 has no talk-only capability.
- L4 (Listener). The HFS 9000 becomes a listener when its listen address is sent with the ATN (Attention) line asserted. The HFS 9000 does not have listen-only capability.
- SR1 (Service Request). The HFS 9000 asserts an SRQ (Service Request) line to notify the controller when it requires service.
- RL1 (Remote/Local). The HFS 9000 responds to both the GTL (Go To Local) and LLO (Local Lock Out) interface messages.
- PPO (Parallel Poll). The HFS 9000 has no parallel poll capability. It does not respond to the following interface messages: PPC, PPD, PPE, and PPU. The HFS 9000 does not send out a status message when the ATN (Attention) and EOI (End of Instruction) lines are asserted simultaneously.

- DCL (Device Clear). When acting as a listener, the HFS 9000 responds to the DCL (Device Clear) and SDC (Selected Device Clear) interface messages.
- DT1 (Device Trigger). The HFS 9000 responds to the GET (Group Execute Trigger) interface message.
- C0 (Controller). The HFS 9000 cannot control other devices.
- E2 (Electrical). The HFS 9000 uses tri-state buffers to provide optimal high-speed data transfer.

Wiring for Alternate RS-232-C Configurations

The RS-232-C cable included with the HFS 9000 connects the HFS 9000 to a standard RS-232-C serial port with a DB-25 female connector configured as DCE (Data Communications Equipment). If your controller is configured differently, you will need to obtain or build a different cable or adapter. The information below will assist a qualified service person to identify or build the necessary custom cable.

Serial Port DB-9 Pin Assignments

The HFS 9000 serial port is a 9-pin male connector with the following pin assignments listed in Table C–3. This port configuration is equivalent to the Compaq personal computer 9-pin serial port.

Table C–3: Serial Port DB-9 Pin Assignments

Pin	RS-232-C Signal Name
1	DCD — Carrier Detect
2	RXD — Receive Data
3	TXD — Transmit Data
4	DTR — Data Terminal Ready
5	Signal Ground
6	DSR — Data Set Ready
7	RTS — Request To Send
8	CTS — Clear To Send
9	RNG — Ring Indicator

Standard Accessory Serial Cable

The standard accessory serial cable supplied with the HFS 9000, Tektronix part number 012-1241-00, connects the HFS 9000 to a standard RS-232-C serial port with a DB-25 female connector configured as DCE (Data Communications Equipment).

In effect, the standard accessory serial cable converts the HFS 9000 to a standard RS-232-C serial port with a DB-25 male connector configured as DTE (Data Terminal Equipment).

Table C–4 shows the wiring of the standard accessory cable. This table also shows the standard cable's effective pin assignments at the DB-25 connector when the DB-9 connector is attached to the HFS 9000.

Table C–4: Standard Accessory Cable Connections

DB-9 Female 9-Pin Connector Pin Number	DB-25 Male 25-Pin Connector Pin Number	RS-232-C Pin Assignments when Cable Connected to HFS 9000
1	8	DCD — Carrier Detect
2	3	RXD — Receive Data
3	2	TXD — Transmit Data
4	20	DTR — Data Terminal Ready
5	7	Signal Ground
6	6	DSR — Data Set Ready
7	4	RTS — Request To Send
8	5	CTS — Clear To Send
9	22	RNG — Ring Indicator

Connection to IBM PC DB-25 Ports

The easiest way to connect to an IBM PC or PC clone is to create a "null modem" or converter. This connects to the IBM PC serial port, and the standard accessory cable connects to the null modem. The converter is non-polarized; it can be connected either way between the standard accessory cable and the IBM PC serial port. The wiring for the null modem is shown in Table C–5.

Table C–5: Converter Wiring for 25-pin PCs

DB-25 Female 25-Pin Connector Pin Number	DB-25 Female 25-Pin Connector Pin Number
1	1
2	3
3	2
4	8
5 and 6	20
8	4
20	5 and 6

Connection to IBM PC DB-9 Ports

To connect the HFS 9000 to an IBM PC or compatible having DB-9 (9-pin) serial ports, do not use the standard accessory cable at all. Instead, obtain a DB-9 to DB-9 cable with the wiring shown in Table C–6. Either end of this cable may be connected to either the HFS 9000 or the IBM PC.

Table C–6: Converter Cable for 9-pin PCs[1]

DB-9 Female 9-Pin Connector Pin Number	DB-9 Female 9-Pin Connector Pin Number
1	7
2	3
3	2
4	6 and 8
5	5
6 and 8	4
7	1

1 Neither connector uses pin 9.

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